[JJ] Evening Poster | A (Atmospheric and Hydrospheric Sciences) | A-CC Cryospheric Sciences & Cold District Environment

[A-CC28]Glaciology

convener:Takayuki Nuimura(Chiba Institute of Science), Ishikawa Mamoru(Hokkaido University), Kzutaka Tateyama(国立大学法人　北見工業大学, 共同), Hiroto Nagai(Japan Aerospace Exploration Agency)
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The cryosphere is a fundamental component of the earth system. It is a region where snow and ice exist in the form of glacier/ice sheet, snow cover and snowfall, frozen ground, sea ice and fresh water ice, and they play a critical role in the global environment under the interactions with atmosphere, ocean, ecosystem and others. In this session, research results on physical and chemical characteristics of snow and ice, variations and dynamics of cryospheric environment, roles of the cryosphere on the earth and other planets will be discussed broadly, regardless of the research method.

[ACC28-P08]Effect of snow impurities on albedo and radiative forcing observed during 9 winter seasons in Sapporo

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The cryosphere plays an important role for the earth energy budget because of its high reflectance and large variation of its areal extent (Aoki et al., 1999). Snow impurities originated from light-absorbing aerosols in the atmosphere have an effect to accelerate the cryospheric warming by reducing the albedo. In Sapporo, a typical snow cover area, it is reported that the snow albedo depends strongly on snow grain size and snow impurity concentration (Aoki et al., 2003, 2007). In this study, we investigated the effect of snow impurity concentration on albedo in Sapporo using physical based snow albedo model (PBSAM) developed by Aoki et al. (2011).The observation site is the meteorological observation field (43° 04' 56"N, 141° 20' 30"E, 15 m a.s.l) of the Institute of Low Temperature Science of Hokkaido University. The observation period analyzed is 9 winter seasons from 2007 to 2016.The observed broadband albedos were compared with the theoretical values calculated with PBSAM to which the observed data of snow grain size, impurity concentration, and downward radiation were input. In addition, we conducted numerical sensitivity experiments on albedo changes due to snow impurities and calculated their radiative forcing (RF).
Comparing the time series of the observed albedo and the model calculated value in each year of the analysis period, the calculated albedo variations due to the change in snow grain size and impurity concentration agreed well with the observations. The determination coefficient (R^2) and the root mean square error (RMSE) in the whole period obtained from the albedo comparison between observation and calculation in the shortwave (SW) region were 0.856 and 0.043, respectively, confirming the high accuracy of PBSAM. Next, sensitivity experiments were conducted on albedo changes in the visible (VIS), near-infrared (NIR), and SW regions depending on the presence or absence of snow impurities which consist of black carbon (BC) and mineral dust. The albedo change due to snow impurities (BC + dust) in the whole period was -0.054 in the SW region. The contributions from BC and dust to the total SW albedo change were -0.046 and -0.008 by BC and dust, respectively. RF due to snow impurities in the whole period was +6.8 Wm^{-2}, in which the contributions from BC and dust to the total RF were +5.5 Wm^{-2} and +1.3 Wm^{-2}, respectively. Furthermore, RFs for the accumulation period and melting period were +2.6 Wm^{-2} and +20 Wm^{-2}, respectively.

References

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Aoki et al., 2003: *J. Geophys. Res.*, **108**(D19), 4616, doi:10.1029/2003JD003506.
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